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II. **Solution by the PROPOSER.**

Let a, b, c, and d be the vector sides AB, BC, CD, and DE, respectively. Then will $EA=-(a+b+c+d)$, $AK=\frac{1}{2}(a+b+c+d)$, $KB=\frac{1}{2}(a-b-c-d)$, $KF=\frac{1}{2}(-a+b-c-d)$, $KG=\frac{1}{2}(-a-b+c-d)$, and $KH=\frac{1}{2}(-a-b-c+d)$.

Squaring these vector expressions for KB, KF, KG, and KH, and adding, their sum is found to be $a^2+b^2+c^2+d^2$. As the square of a vector equals minus the square of its tensor, the truth of the proposition is demonstrated. Observe that a line drawn from D to K is equal to and may be substituted for KH in the equation of the problem.

378. **Proposed by G. I. HOPKINS, A. M., Instructor in Mathematics and Astronomy, Manchester High School Manchester, N. H.**

In the triangle AED, the lines BE and CE are drawn to the points B and C in the base of the triangle. If $AE=100$, $ED=125$, $BC=60$, and $\angle AEC=\angle BED=$a right angle, compute AB, BE, EC, and CD.

Solution by A. H. HOLMES, Brunswick, Maine.

Put $DAE=\theta$ and $ADE=\psi$. Let fall perpendicular EF on base AD. Then we have, $100\sin\theta=125\sin\psi$ or $4\sin\theta=5\sin\psi$... (1).

Since BED and AEC are right angles, $BD=\dfrac{DE}{\cos\psi}$, and $AC=\dfrac{AE}{\cos\theta}$.

$\therefore\ \dfrac{100}{\cos\theta}+\dfrac{125}{\cos\psi}-60=100\cos\theta+125\cos\psi$... (2).

Eliminating $\sin\theta$ and $\cos\psi$ from (1) and (2), and reducing,

$\cos^6\psi+.96\cos^5\psi-3.1296\cos^4\psi-.0256\cos^3\psi+1.94745\cos^2\psi-.1152\cos\psi=0.$

Solving by Horner's method, $\cos\psi=.8851+$. $\therefore\cos\theta=.8134+$.

Then since $AC=122.94+$, $AB=62.94+$.

Similarly, $CD=81.22+$. Also, $BE=65.71+$, and $CE=71.51+$.

Also solved by J. Scheffer.

382. **Proposed by PROF. R. C. ARCHIBALD, Brown Uniuersity, Providence, R. I.**

Between the side of a given rhombus and its adjacent side produced, to insert a straight line of a given length and directed to the opposite corner. "Euclidean constructions" are particularly desired.

Remark by V. M. SPUNAR, M. and E. E., Chicago, Illinois.

This is the famous Pappus problem: Rhombo dato et uno latere producto aptare sub angelo exteriori magnitudine datum rectam lineam, quae ad oppositum angulum pertingat.

Pappus, and a certain number of mathematicians, among them Newton, Huygens, and Gergonne, solved the problem algebraically and geometrically. (See E. Pruvost, *Geomètrie Analytique*, t. I, pp. 18-28.)

The problem in the present form, proposed by Prof. R. C. Archibald

in *l'Intermediaire de Mathematiciens* as Question 3667, suggested to Prof. P. Barbarin (Paris) a more general problem, viz., *Mener par un point donné dans un angle une secante de longueur donnés,* of which a complete solution has been published by himself in *l'Enseignement Mathematique* (XIII^e, 1, 1911, pp. 15-23).

The investigation is carried out analytically, and the following conclusions have been drawn. The generalized problem is solved algebraically by an equation of the third or fourth degree, and graphically by the intersection of a circle with an hyperbola. Special cases have been shown where the general equation can be lowered to second degree (where the Euclidean construction is possible). There is also a particular case, where the problem is reduced to that of the tri-section of an angle.

A solution of this problem as No. 364 is given by C. N. Schmall on page 140-141, Vol. XVII of the MONTHLY.

MECHANICS.

253. Proposed by W. J. GREENSTREET, M. A., Editor, The Mathematical Gazette, Stroud, England.

R_1 and R_2 are ranges on a horizontal plane of particles projected with given velocity from A on the plane to pass through B. Show that $a(R_1+R_2)-R_1R_2=\dfrac{a^4}{c^2}$, where $c=AB$ and a is the horizontal projection of AB.

I. Solution by S. G. BARTON, Ph. D., Clarkson School of Technology, Potsdam, N. Y.

Let h be the distance of B above the horizontal plane, v the velocity of projection, α and β the two angles of projection which make the particles pass through B. Let $2v^2/g=m$.

$$R_1=\frac{m}{2}\sin 2\alpha=\frac{m\tan\alpha}{1+\tan^2\alpha},\quad R_2=\frac{m\tan\beta}{1+\tan^2\beta}.$$

$$R_1+R_2=\frac{m(\tan\alpha+\tan\beta)(1+\tan\alpha\tan\beta)}{(1+\tan^2\alpha)(1+\tan^2\beta)},\quad R_1R_2=\frac{m^2\tan\alpha\tan\beta}{(1+\tan^2\alpha)(1+\tan^2\beta)}.$$

The equation of the trajectory is

$$y=x\tan\alpha-\frac{x^2}{m}\sec^2\alpha=x\tan\alpha-\frac{x^2}{m}(1+\tan^2\alpha).$$

Since B lies on this, we have $h=a\tan\alpha-\dfrac{a^2}{m}-\dfrac{a^2\tan^2\alpha}{m}$.